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Logwood: The Historic and Standard Black

THE historic and standard black on wool is Logwood. Early recognized as without a rival for the production of fast and handsome blacks on wool, Logwood for centuries was accorded a position of pre-eminence whenever the coloring of black fabrics was considered. With the development of chemical science, Logwood was seen more clearly than ever to possess numerous peculiar excellencies for the production of blacks on fabrics. It was accordingly adopted as a standard of comparison and new products were compared with Logwood and were praised or condemned according as they equaled or fell short of the Logwood standard.

Despite unwearying attempts by armies of chemists during the recent decades, no perfect substitute for Logwood has yet been synthesized. For certain special purposes, where particular or unusual effects or fastnesses are needed, Logwood may not be applicable, and specially prepared artificial blacks may be required. Where, however, a particularly handsome and fast black is desired, Logwood, on account of its fundamental excellencies and superiorities, should be and is employed. The Logwood effects cannot be equaled with artificial substitutes.

In America particularly, nevertheless, where large production is required regardless of the properties of the resultant fabric, Logwood has for some classes of work been displaced by acid or chrome-top blacks, with the production of noticeably dead or deficient colorings. The climax of this movement came with the production of blacks neither bloomy nor full, hardly to be called blacks at all, and a range of shades that were designedly full and lifeless. From this position the trade is revolting; the coming season, say all who are familiar with trade development, will witness a revival of demand for rich heavy blues and blacks. This means logically a turning to Logwood.

The reasons why Logwood should be turned to for the production of handsome and fast blacks have since antiquity been written in the history of dyeing. However, it will be of interest to gather together certain of these facts. The reasons for the persistent pre-eminence of Logwood as *the* black on wool may be grouped under three heads: First, chemical reasons, then tinctorial, and lastly dyeing.

Chemically, Logwood is a true black. A true black is a product which has the power to color the fiber a blue shade

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and then to continue coloring the fiber until a black shade develops. Thus two products of synthesis may in thin shades dye nearly identical blue tones and may at first glance seem similar blacks. The simple test of adding increasing percentages of color to the dye-baths will establish or overthrow their similarity; for then a product which is only a blue will always stay a blue, while the true black will pass from dark blue to blue black and finally to black.

Logwood, in comparison with other true wool blacks, may rightly be called in this respect a most satisfactory product,—in fact, perhaps, *the* most satisfactory of all. An astonishingly large amount of Logwood can be piled on the fiber with not only no detriment to the shade and properties of the black produced, but, on the other hand, a positive benefit. Whereas 2 to 5 per cent of a good Hematine Paste will give respectively medium and dark blues, 10 per cent will give a rich blue black; but so will 15 and 20 per cent go on and increase the solidity, beauty, and fastness of the black. With other blacks a maximum of color that may be applied is sooner or later reached, and then with successive increments of color the shades of the blacks become brown or bronzy or otherwise perverted, and the resultant dyeings crock or even dust off and are generally unsatisfactory.

Logwood Superior Black Tinctorially

The chemical superiority of Logwood as a black is doubtless accentuated by its superior tinctorial properties. The underhand solid blueness and the overhand lofty bloom of Logwood blacks on wool are proverbial. It has been the despair of the artificial color chemists to secure one synthesized product combining these peculiar desirable properties. Synthetic blacks that have been judged worth presenting to the trade have usually not been true blue blacks, but rather a succession of the most bizarre off tones: greenish toned blacks, reddish or brownish blacks, violet blacks; and in the case of top-chrome colors, violets, browns or even reds, only changeable into blacks by after-treatment in the dyeing bath with chrome. In Logwood the laboratory of nature seems to have given ready at hand a true black and a true blue black, which can be imitated but not equaled.

A true black is always preferred for the production of rich black shades. Rich colorations of any shades, be they black, blue, red, green or brown, are always made by piling on the fiber or fabric heavy percentages of the purest, brightest colors obtainable. This gives a rich, solid body and a beautiful, lofty overhand bloom. For blacks for this purpose Logwood is peculiarly adapted; its ability to dye heavily on the fiber with a beneficial intensifying of the pure blueness and rich bloom, as has been explained, in comparison with the action of off tone artificial blacks, leaves in the matter little choice.

The artificial off shade products are, however, not willingly brought on the market. On the contrary, to remedy the tinctorial defects of these straight product syntheses, the artificial color makers have resorted to the expedient of mixing or toning their products, and accordingly we have offered as "perfect" substitutes for Logwood a myriad of mixtures, which, while they are perhaps improvements in shade and properties over the straight articles, possess all the defects of mixed products. Thus well-known brands of artificial blacks are variously mixtures of a greenish and a reddish violet black with or without orange, red and yellow toning; of a greenish black with orange, red and yellow; or a dull reddish black lifted with a bright blue; or some other combinations of the colors at the disposal of the artificial black manufacturer, by mixing of which he hopes to avoid the "off shade" criticisms of his products.

But in avoiding one evil the artificial color manufacturer has run completely

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into another and greater; to borrow the classical comparison, steering clear of Scylla he runs smash against Charybdis. A straight homogeneous product, other things being equal, is preferred by expert dyers to a mixed product. It is apt to work better and more uniformly. The essential straight chemical homogeneity of Logwood is fully established and a matter of common knowledge. Not a little of the perfect action of Logwood in coloring deep handsome blacks is due to this homogeneity. Mixtures containing chemically dissimilar blacks, one a greenish black, for instance, and another a purplish black, or containing a black base toned with different acting colors, red, orange, or blue, cannot be expected to work, and as a matter of fact, they do not work as uniformly and well in dyeing as a straight homogeneous black.

If Logwood contained no further valuable properties, but on the other hand many striking defects, the peculiar excellencies and superiorities that have just been considered would account for its pre-eminence as *the* black on wool, its astounding vitality against repeated assaults, and would insure its continued use by intelligent managers.

Advantages of Logwood in Dyeing

The dyeing reasons which have made Logwood a favorite are especially noteworthy. In this connection, for a fair judgment, should be considered first the dyeing requisites of a satisfactory dyestuff, and also the effect of other factors entering into the making of the goods on dyeing (and dyestuff) requirements.

The requisites of a satisfactory dyestuff, considered simply from the standpoint of its behavior in the dyeing operations, may be grouped roughly under three heads: First, uniformity of action, then leveling properties, and finally power of penetration. These properties are closely related to one another. The most uniformly acting dyestuffs are usually the best levelers. The best penetrating dyestuffs will usually color the most solid and even shades. The colors which dye slowly usually combine most perfectly these desired properties.

Faults in any of the requisites, on piece goods, will produce spots, streaks, mixed effects and clouds; and on raw stock uneven colorings that even the most capable spinning cannot overcome.

The hardest test of the value of a dyestuff in dyeing is to feed it at a boil. Quickly dyeing colors will snap on the surface of the goods unevenly, and in the majority of the cases no amount of subsequent boiling will level them. Few dyestuffs, particularly among blacks, can stand this test. Yet the necessity of feeding at a boil is, with dyers, always imminent and frequently pressing.

The effect of factors entering into the making of the goods, outside the direct control of the dyer, on dyeing opera-

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tions and dyestuff requirements, is extraordinary, and, as a rule, is greatly under-estimated. The tasks of dyeing, at all times not inconsiderable, can be made much harder by those who are responsible for the goods before and after the dyeing operations, or they may, by intelligent management and capable workmanship, be greatly diminished in difficulty.

To illustrate: Defects in designing fabrics may vastly and unnecessarily increase the difficulties of dyeing. A fabric may be so designed as to be almost impossible of penetration.

The choice of stocks likewise has a tremendous influence in increasing or decreasing the difficulties of dyeing. Certain grades of wool can be well colored, if at all, only by the most versatile and resourceful master of the art of dyeing; it is frequently practically an impossibility to color evenly certain blends of different stocks. Nevertheless, again and again, after the dyer has overcome all such difficulties and is obtaining satisfactory results regularly and smoothly, an unthinking official upsets everything; without warning the dyer, he blends into the goods a different quality of stock, possibly material left over from a previous season or a "snap bargain," and the deed is done. The dyer has to work out his own salvation as best he can.

So also the preparation of the goods before the dyeing is equally fundamental and far-reaching in happy or ill-effects. The overcoming in the dyehouse of defects in the wet finishing is at times little more than a forlorn hope. Seconds are inevitable until processes in other stages of the manufacture have been perfected or standardized.

The remarks relative to the wet finishing also apply to the dry finishing. It is indeed happily true that clever and capable finishings can at times overcome defects in dyeing, but in the vast majority of cases where trouble arises the fault is the other way round, not in the dyeing, but in the finishing. Careless finishing, or an attempt to rush matters for increased production, or

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some untoward, unnecessarily severe after-process, may be responsible for spoiling excellently colored goods.

The successful dyer accordingly selects his dyestuffs with a full understanding of the essential pre-requisites of a good dyestuff under favorable conditions and an eye specially open to their adaptability and characteristics under adverse circumstances. That dyestuff which possesses superior dyeing properties under ordinary conditions, and also enables him to surmount the greatest number of obstacles under extraordinary conditions, he will prefer and welcome.

Such a dyestuff is Logwood. It colors uniformly, levels excellently, and penetrates perfectly. It dyes slowly. It may be fed at the boil. Faultily designed goods and the widest variety of blends of stock are evenly colored and penetrated by Logwood. Defects in wet and dry finishing are most successfully offset by its use.

Such cannot be said in the same measure of the artificial substitutes offered against Logwood. Lack of space will not permit of going into the great mass of details necessary for a full and an exact statement of the dyeing departments of the many artificial substitutes that have been placed on the market. Few, if any, artificial blacks, particularly among the chrome-top blacks, which are offered specially against Logwood, can be fed at the boil. The vast majority of synthetic products dye quickly, and those that do not are usually at the other end of the scale—dye with excessive slowness and require large quantities of oil of vitriol for their exhaustion; few strike the happy Logwood medium. Many artificial blacks possess certain extremely desirable characteristics, but unfortunately they also possess the defect of too quickly exhausting on the goods, or of going on only with extreme difficulty. As a result, stock and goods are not colored uniformly, the dyeings cannot be leveled up and the penetration is poor.

The top chrome or after-chrome black, the most dangerous rival of Logwood, labors further under a specific disadvantage. The great change in shade that occurs in the final chroming from purple, brown or even red to black, constitutes a source of danger and trouble.

The artificial substitutes for Logwood which are open to real criticism under favorable circumstances naturally can offer no assistance in offsetting the special troubles arising from unfavorable conditions outside the dye-house. The essential chemical homogeneity and uniformity of Logwood and its true blueness as a black, combined with the peculiar superior dyeing properties that have just been discussed, explain its preference by thoughtful and capable dyers.

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Classification of Dyes From Indigo

In a decision by the Board of United States General Appraisers the collector's assessment of duty on certain coal tar colors imported by A. Klipstein & Co. is affirmed. In this ruling Judge Brown writes as follows:

"The issue involved in this case is whether coal tar color dyes are free of duty under paragraph 514, Act of 1913, as 'dyes obtained from indigo,' as claimed in the protests, or whether said dyes were properly classified under paragraph 20, Act of 1913, providing for coal tar colors or dyes at 30 per cent. ad valorem.

"At the trial the claim was limited to merchandise described at Ciba Brown R. Paste.

"On behalf of the importers, testimony was taken by the deposition of the chemist and director of the manufacturing company in Basle, Switzerland. The witness, by his answers to interrogatories and cross-interrogatories, showed that the merchandise, the classification of which is in dispute, was manufactured from an indigoid, that is, from a substance containing the color group of indigo known as Diamidoindigo. This substance is then brominated, the bromine replacing certain atoms.

"In the case of the United States vs. Hensel, Bruckmann & Lorbacker (7 C. A. R. 391; 32 Treas., Dec. 89), the court held that the provision for 'dyes obtained from indigo' covered only dyes manufactured from indigo itself and did not include similar dyes, or dyes precisely alike, in the manufacture of which the complete indigo formula did not exactly appear.

"Upon the frank admission of the witness that this merchandise was not made directly from commercial indigo, and that in the manufacture the technical formula of indigo itself did not appear, we hold that it was properly excluded from free entry.

"The protests are therefore overruled."

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British Dyes After the War

IN the last four years the United States and England have created and built up dyestuffs industries which satisfy the needs of textile and other manufacturers who formerly relied upon imports from Germany. In this country we are not only making enough for ourselves, but are exporting a large surplus. Undoubtedly, in some way the new industry here will be preserved after the war and defended against Germany's attempts to regain her old market. About $200,000,000 has been invested in it, and if chemicals and drugs be added the total is $380,000,000.

What are England's plans for defending her dyestuffs industry when, after the coming of peace, Germany shall strive to restore her old export trade? The Balfour Committee on Commercial and Industrial Policy After the War has recommended that the importation of goods of enemy origin shall be prohibited, subject to license in exceptional cases, for at least one year. With respect to dyestuffs, however, there is some departure from the general policy. Sir Albert Stanley, President of the Board of Trade, recently said in the House of Commons that the British Government approves control of dyestuff imports by licenses for at least ten years. It is proposed that authority to grant or to withhold licenses shall be given to a commission composed of dye-makers and dye-users, an equal number of each class, with an independent chairman appointed by the Board of Trade. This commission is to have a free hand, and its decisions will be final.

If this plan be made effective, it can be foreseen that Great Britain's imports of German dyes for ten years after the war will be a negligible quantity. We are now sending aniline dyes to England, and these exports will not be checked, so long as the colors are needed there. There will be licenses for the American product. While it may not be expected that we shall use similar methods for defense, this license system deserves some consideration here. We have tariff duties and laws against the "dumping" of foreign goods in our market at prices below cost of manufacture and ocean transportation. The Tariff Commission is deeply interested in our new dye industry, whose growth it has promoted, and the Federal Trade Commission will oppose competition from abroad that is unjust to our manufacturers.

Bluestone

In view of the increased demand for bluestone, that has followed the revived use of natural dyestuffs, every dyer and buyer should know something of the properties and sources of supply of this chemical.

Crystalline cupric sulphate, as bluestone or blue vitriol is scientifically termed, when one hundred per cent pure contains 25.46 per cent of copper and 36.07 per cent of water of crystallization. When a crystal is heated above 212 degrees F. it at once commences to lose its blue color and its surface becomes covered with a white powder. When the crystal is produced from an acid solution, this loss of water of crystallization will take place in a short while on exposure to sunlight and a drying atmosphere at weather temperatures, but when its generation is from a neutral liquid, the crystal exhibits much greater resistance to decomposition. The white appearance of dehydrated crystals in a lot of commercial bluestone is therefore, not, as some consumers believe, an indication of inferior quality.

Bluestone dissolves in about three

parts by weight of cold water and in about one-half part of boiling water. Inasmuch as small crystals can be made to dissolve at a much greater rate than large and because no appreciable difference in the copper content of large and small sized crystals should exist in the product of a reliable manufacturer, it is of advantage, whenever speed in the operation of dissolving is a consideration to use the finer brands of bluestone. The small crystals, however, from some sources carry considerable quantities of water, insoluble substances such as basic sulphates or arsenites of copper, iron or zinc, sulphates of lead or lime, ferric oxide, oxide of antimony, clayey, silicious or organic matter. Even silver and gold to the extent of a nominal value of several cents per ton of bluestone is frequently found in this residue.

The common impurities of bluestone, depending upon its source, are iron, nickel and zinc. The last is found in the product derived from pickling liquors from brass mills, or from the wet process method of reclamation of brass waste. By process of leaching roasted copper-bearing ore, or a copper blast furnace product called matte with sulphuric acid and repeated crystallization, bluestone of varying purity is obtained from the resultant liquor. The most refined product of such processes rarely contains more than ninety-eight per cent of cupric sulphate and carries usually a large percentage of insoluble matter.—*Textile World Journal.*

New Drug Companies

The total capitalization of new companies formed for the purpose of manufacturing drugs, chemicals and dyestuffs in the month of May fell far below the records of the preceding months of this year. Only $1,200,000 in new money entered the drug business in May, as compared with $3,980,000 in April, $13,635,000 in March, $21,250,000 in February, and $11,125,000 in January. The aggregate for the entire war period now stands $378,987,000.

DYESTUFFS

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The School of Dyeing

By A. F. Musgrave

Editor's Note:—*The following is a more or less elementary treatise explaining the nature and methods of use of several well known colors. While designed to instruct the garment dyer and appearing originally in the "National Dyer and Cleaner," we feel that much of the article should be of interest to readers of the* Reporter.

Alizarine and True Mordant Colors

A BRIEF survey will be made of these colors and the methods by which they are applied. It is very seldom that a garment dyer needs to use a dyestuff belonging to this class, but it is interesting to know in what ways they differ from the foregoing dyes.

Alizarine, the oldest member of the group, has been known for a long time as it is the active coloring principle in the madder root which was used by the ancients. At the present day the artificial alizarine has driven the natural product from the market owing to the fact that clearer shades can be produced, and that the various shipments are better standardized as to strength. Alizarine does not produce a satisfactory color by itself, and for this reason it must be applied to the fiber in conjunction with some other product which will form a colored insoluble body. The product, which is combined with the alizarine to form this insoluble body, must have certain properties in itself; or, in other words, it must react with the wool fiber and be made insoluble thereby. In brief, the process consists in treating the wool fiber with a metallic salt which breaks up and deposits on the wool fiber a body which, in the dyeing process proper, has a strong affinity for the coloring matter.

For the mordanting process, therefore, it is necessary to use a chemical compound which is broken up by the basic nature of the wool fiber, and certain chromium salts, particularly potassium bi-chlorate, are very suitable for this work. If wool fiber is boiled in a solution of potassium bichromate, which is called chrome in the dyehouse and will be called by this shorter name in this article, the chrome is broken up and an insoluble oxide of chrome is deposited on and within the fiber. This insoluble oxide has a strong attraction for certain dyestuffs, combining with them to form colored bodies of great fastness.

When the mordanting is carried out by boiling the wool fiber in a simple bath of chrome, the chromium oxide, which is precipitated onto the fibers, is not in the proper form to produce the best colors. The reason for this is that in this case the deposited oxide has acid properties which tend to destroy some of the color during the subsequent dyeing. For this reason it is usual to add certain other chemicals to the mordanting bath in order to reduce the oxide to its basic state. Any reducing agent is suitable for this work, the principal ones in practical use being cream of tartar, lactic acid, lignorosine, etc. This cream of tartar is not to be confused with the tartar emetic which is used for the mordanting of cotton when dyeing with basic dyes. In fact the processes of mordanting cotton and wool are entirely different inasmuch as there is no chemical action between the cotton fiber and the mordant.

The following receipts show how the mordanting is carried out in practice:

	Light Shades per cent	Medium Shades per cent	Dark Shades per cent
1—Chrome	2	3	4*
Tartar	2	2½	3†
2—Chrome	1	1¼	2
Lignorosine	2	3	4†
Acetic acid	2	3	3†
3—Chrome	1½	2¼	3
Lactic acid	2½	3¾	5†
Acetic acid	2	2½	3†

* Mordanting Agent.
† Mordanting Assistant.

The properly cleaned wool is boiled for from ninety minutes to two hours in the above baths. It is then rinsed

after which it is ready for dyeing. The mordanted material should not be allowed to lie about for any great length of time before the dyeing process is started as the light affects the mordant. In this case uneven dyeing is very liable to result.

The alizarine colors may also be applied to cotton, although it is necessary to mordant the fiber. The principal use of alizarine colors on cotton is for the production of Turkey red by dyeing alizarine over an oil mordant. This process is rather complicated and of no commercial value to the garment dyer so that it will not be discussed at this time.

It is well known by garment dyers that badly faded goods are dyed more evenly by first treating in a boiling bath of chrome, and in reality this is a simple mordanting.

Sulphur Colors

The sulphur dyes, although not of great interest to the dyer of garments, may be described briefly as they are, as a class, very fast and very interesting. The sulphur dyes have not been well investigated and not much is known regarding their constitution. In many respects they resemble the direct dyes in that the cotton fiber shows a strong attraction for them. It is not necessary, therefore, to make use of mordants for their application. In one very important particular they are different from direct dyes. This is that they are not soluble in water. This accounts for the fact that these dyes are very fast to washing. The range of colors in the sulphur group is not as good as that of the direct class, there being very few good bright shades. The class comprises yellows, dull oranges, browns, greens, blues, dull violets, dull maroons and blacks.

A few of the sulphur dyes have very good fastness to light, but as a class it is impossible to say that their light fastness is very good. The wash fastness of all is considerably better than that of the direct group, while the fastness to acids and alkalies is also good. The sulphur dyes have one bad fault. This is that when the material is first taken from the dye bath the shade will keep changing for some time. This change is due to the oxidation of the color by the air. For this reason it is usually the practice to give the dyed goods a treatment which will bring about this oxidation rapidly and thus show the dyer just where he stands. Among the oxidizing agents used for this purpose may be mentioned chrome, bluestone, peroxide, perborate, bisulphite and magnesium sulphate. Of course all of the sulphur dyes do not change to the same degree. The writer has in mind two sulphur browns, the first of which when first taken from the dye bath is a green-

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ish brown, and in time develops to a bright reddish orange. The second becomes slightly redder. The writer has also wondered whether or not there is any relation between the degree of oxidation change and the fastness of the resulting color. Of the two dyes mentioned above the one which changes to the greater degree is much less fast to light than the other, but an isolated case like this does not necessarily mean that the rule holds true for all colors. It is well known that in the after-chrome class of colors, those dyes that are changed most by the chrome give the fastest shades.

In order to dye the sulphur dyes it is necessary to make use of a dyeing assistant which is not used on any other group of dyes. This dyeing assistant is sodium sulphide, which is prepared by heating sulphur and caustic soda together. Sodium sulphide comes on the market in two forms. As crystals containing a large amount of water, and as chips or blocks containing no water. The latter form is called sodium sulphide concentrated, and has twice the strength of the crystals. The function of the sodium sulphide is to reduce the sulphur dye to a soluble state. Soda ash is also used in the dyeing of this group of dyes, its function being two-fold: First, to soften the water and, secondly, to react with any hydrogen sulphide that is liberated and combine with it to form sodium sulphide. Other assistants are the well-known common and Glauber's salts which are used for the same purpose as when dyeing the direct dyes.

Not all of the sulphur dyes require the same amount of sulphide in order to dissolve them, the amount being dependent, of course, on the concentration and purity of the color. Owing to the fact that the sulphur dyes do not exhaust very well, it is usual to keep standing baths for black and for dark shades. It is, of course, a very difficult matter to keep standing baths of tans, etc., where the shade is produced with three separate dyes, owing to the fact that the different dyes do not always exhaust in the same ratio. The sodium sulphide, which is used for the dyeing of sulphur dyes, does not in itself have any harmful action on the cotton fiber; but if it is not thoroughly washed out of the goods after the dyeing it may eventually become oxidized to sulphuric acid and then produce tendering. For this reason it is necessary to give the dyed material several rinses.

The majority of the sulphur dyeing is done at the boil, and the goods should be kept under the liquor as much as possible in order to prevent the formation of streaks due to the oxidizing action of the air. Certain of the sulphur blues are best dyed at about 160 degrees F., these being the blues which reduce to a yellow in the dyebath. A typical receipt for dyeing with sulphur dyes is as follows: Make up a dyebath composed of ten per cent of soda ash. These are boiled together to dissolve the color and from thirty to fifty per cent of salt is then added to the dyebath.

The dyeing is carried out at the boil for one hour. The material is then squeezed and rinsed, except for certain blues which must be oxidized before

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they are rinsed. The after-treating, when desired, is done after the material has been rinsed. The simplest and best after-treatment for quick oxidization being carried out with one per cent of perborate of soda, at a temperature of one hundred degrees F., for fifteen minutes. In addition to bringing out a rapid oxidization, the use of chrome and bluestone in the after-treatment also considerably increases the fastness to light and washing.

An important fact not mentioned before is that the dyeing of these colors must be carried out in iron or wooden kettles, no brass or bronze fittings, or copper, being permissible.

Vat Dyes

The vat dyes are the latest group of dyes to be placed on the market, and they are widely used on account of the fast and brilliant shades which they produce. The vat dyes as a class resemble indigo in that they are applied in the same manner. While they are not of interest to the garment dyer in the commercial sense, a brief survey of the methods of applying them will no doubt be of interest.

The vat dyes are sold as pastes or powders which are insoluble in water, and in order to bring them into a state of solution so that the cotton fiber can take them up, it is first necessary to change them to a soluble form. This is accomplished by reducing them with sodium hydrosulphite and alkalies. Take, for instance, a certain well-known blue which the dyer wishes to dye. He would take from ten to twenty per cent of dye paste and mix with it about twice its volume of warm water. He would then add, figuring on the weight of the dyestuff taken, twenty-five per cent of caustic soda, forty per cent of soda ash, ten per cent of soluble oil and thirty per cent of hydrosulphite. He would then keep the above mixture at 140 degrees for about thirty minutes. The color of this solution would then be a golden yellow. The dye tub is then filled with water at 140 degrees F. and one pound of hydrosulphite added for each three hundred gallons of water. The dissolved color is then added. The dyebath is now yellow with a blue scum on top. The goods are then added and turned well, keeping them under the liquor as much as possible, for about fifteen minutes. They are then taken out and squeezed quickly and then allowed to hang in the air for thirty minutes. When first taken from the dyebath the goods are a yellow color but rapidly become blue. At the end of thirty minutes the goods are given another dip for the same length of time, squeezed and oxidized as before. The goods are then given a soaping at the boil, which in some cases makes a considerably different and deeper shade. The dyeing is then finished and the dyebath is kept for future lots.

The above sounds simple but it is a

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fact that the vat dyes are the most difficult of all dyes to apply satisfactorily. It is, of course, a rule of dyeing that the faster the dyeings to be produced the more skill there is required on the part of the dyer.

While all vat dyes are not applied with just these amounts of chemicals, the principle is the same. Those dyes which change least in color when in a reduced state, or, in other words, those which show the least oxidation change are the easiest to dye level. At the present time the bulk of these dyes are used for stripes for shirtings—for which they are well adapted owing to their fastness to chlorine—for embroidery silk, etc.

Ingrain or Ice Colors

This is another class of colors which are not used by the garment dyer, but which, for the sake of completeness, will be briefly described.

Among them may be mentioned Para Red, Alpha-naphthalamine Claret, Dianisidine Blue. Other colors which are produced on the fiber but which are not properly ice colors are Aniline Black, Fast Printing Green, Fur Blacks, etc. Still certain other colors which may be described briefly are the so-called mineral colors such as Chrome Yellow, Iron Buff, etc.

Para Red—This color is produced on cotton goods by first preparing the cloth with a solution of Beta Naphthol and then passing through a solution of diazotized para nitraniline. Great exactness and care is necessary in producing this color in order to secure good results.

Alpha-naphthalamine Claret — This color is produced on cotton cloth by impregnating the fiber with Beta Naphthol and then passing through a solution of alpha-naphthalamine.

Dianisidine Blue—This color is prepared from a bottom Beta-Naphthol, passed through diazotized dianisidine and then after-treated with copper salts.

Aniline Black

Without doubt Aniline Black is one of the fastest blacks that can be produced on the cotton fiber. Aniline Black in itself is not a true dyestuff, as it can be produced on the fiber only in an insoluble condition. For dyeing Aniline Black the goods are treated with a solution of aniline hydrochloride and this is then oxidized to form Aniline Black. Aniline Black is used largely in cotton printing. It is not used on wool or silk owing to the difficulty of applying it to these fibers.

There is also a so-called, one-bath Aniline Black which is sometimes used

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over a bottom of sulphur blacks. In this process the aniline hydrochloride, acid and oxidizing agent are all put into the same bath, and the color is thus produced partly in the bath and partly on the fiber. As might be expected, dyeings made in this manner have more tendency to crock than those produced by the two-bath method.

Fur Blacks and Browns

The various chemicals that are used to produce colors on furs are para phenylene diamine, para amido phenol, meta phenylene and many others. Para phenylene diamine is the most important as it is used for blacks. These chemicals are oxidized upon the fiber in order to produce the colored body. To give detailed instructions for the production of these colors on furs would be to change this article from a study of dyes to a study of fur dyeing and this cannot be done at this time.

Mineral Colors

Although not of great interest at the present time it will be well for the dyer to know these colors and how they are produced. Chrome yellow is the insoluble pigment produced by the interaction of a lead and chromium salt. The cotton fiber is first impregnated with the lead salt and is then passed through a chromium bath which produces a yellow. As might be expected from the lead present this color has poisonous tendencies.

Iron buff, also known as khaki, is the shade produced by the interaction of certain chromium and iron salts with caustic soda, and, therefore, it is a mixture of the oxides of iron and chromium. The color is very fast and has been extensively used for army goods, particularly by the British government.

There are, no doubt, many interesting dyestuffs which have not been mentioned in this series of articles, but to go into detail with every color would mean a volume of about eight hundred pages and even this would not cover the whole process of dyeing. When one considers that there is practically an unlimited number of possible dyestuffs of the coal tar class, and that new ones are being discovered every day, he is able to realize that to master the dyeing industry is not a matter of a few years but of a life time. While I realize that there are many things in this series of articles which will not be of use to the garment dyer in his daily work, still I believe they will stimulate interest and cause more study to be given to the dyestuffs in daily use, thus tending to improve the dyer's work.

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